CT DEEP Fish Tissue Contaminant Monitoring Project

Analysis of Chlordane Levels in Fish Tissue Collected from Union Pond & Shenipsit Lake

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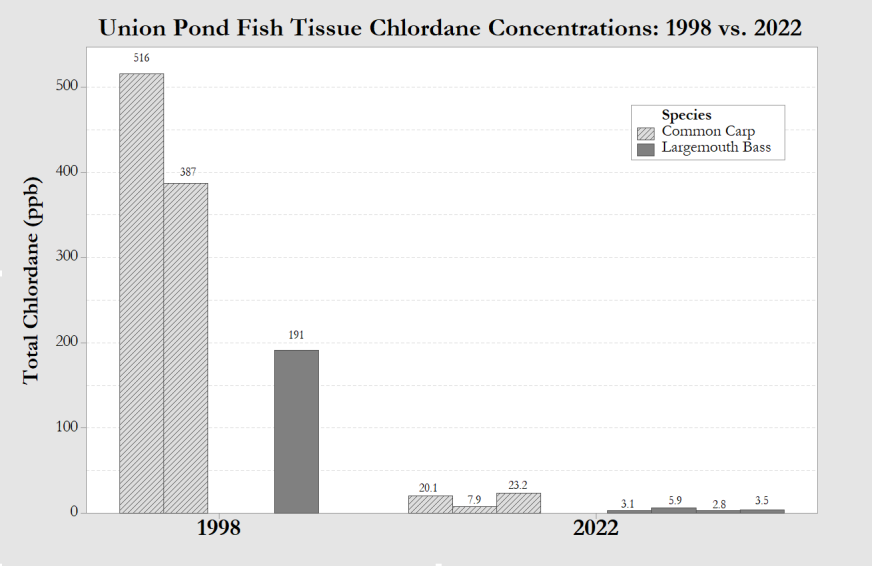
Executive Summary

Union Pond is an impoundment of the Hockanum River located in Manchester, CT. In 1999 the Connecticut Department of Public Health (CT DPH) issued a 'do not eat' fish consumption advisory for carp, catfish and bass collected from the waterbody due to concerns over elevated chlordane levels. The Connecticut Department of Energy and Environmental Protection (CT DEEP) has similarly listed the waterbody as impaired for fish consumption use. This study therefore sought to determine whether total chlordane concentrations in fish tissue collected from Union Pond have decreased to levels that would allow safe consumption by the public and removal of the water quality impairment.

On June 23, 2022, CT DEEP staff collected 15 Largemouth Bass, 15 Common Carp and 15 White Sucker from Union Pond for analysis. (Catfish, which are included in the consumption advisory, were not observed during the sampling effort.) In addition, on June 13, 2022, 15 Largemouth Bass were collected from nearby Shenipsit Lake, a local drinking water source with no history of chlordane contamination, for comparison. (Common Carp and White Sucker were also targeted but not observed during the sampling effort.)

All fish samples were analyzed by the University of Connecticut's Center for Environmental Science and Engineering laboratory in Storrs, CT on October 14, 2022. Samples were analyzed as composited, skin-on fillets. Total chlordane was calculated as the sum of oxychlordane, trans(gamma)-chlordane, and cis(alpha)-chlordane, on a wet weight basis.

Chlordane was detected in all fish samples collected from Union Pond. Total chlordane concentrations were higher in bottom feeding species than in predator fish. The maximum total chlordane concentration detected in Union Pond bass was 5.92 ng/g (ppb), while the maximum concentration in carp and suckers was 23.21 and 15.99 ng/g, respectively. Although total chlordane levels in Union Pond fish tissue appear to remain elevated above background levels (i.e., Shenipsit Lake fish tissue concentrations), they are substantially lower than those observed in 1998, and may support removal of chlordane-based water quality impairment for Union Pond.



INTRODUCTION

The CT DEEP and the CT DPH have a long-term, ongoing relationship to evaluate fish tissue contamination in Connecticut in order to protect human and environmental health. This collaboration maximizes the benefit of available resources (e.g., technical expertise, field and laboratory staff and equipment, and funding resources) in order to provide for the collection and analysis of data that is mutually beneficial. CT DPH utilizes the data to inform public health advisories related to fish consumption, while CT DEEP utilizes the data to assess water quality conditions. Fish tissue contamination monitoring efforts in Connecticut have focused on a range of pollutants including PCBs, mercury, pesticides, radiation, per- and polyfluorinated alkyl substances (PFAS) and microcystin.

STUDY BACKGROUND

Chlordane, a chlorinated cyclodiene, was manufactured in the United States beginning in the late 1940s as a multipurpose insecticide. From the early 1940s to the late 1980s, chlordane was used extensively in home and agricultural applications in the United States for the control of termites and many other insects. It has since been classified as a human neurotoxicant and after an initial phase-out, all uses were completely banned in 1988 (US EPA 2000).

In 1998, the University of Connecticut (UConn) Environmental Research Institute (ERI) carried out a statewide investigation of total chlordane, total DDT and total PCBs levels in fish tissue from Connecticut lakes and ponds. Fish were collected from 16 lakes, including Union Pond in Manchester, CT. Fish tissue samples consisted of composited skin-on fillet from three fish each. Of the 16 study lakes, only 7 lakes had detectable levels of chlordane; Union Pond was the only lake with levels that exceed the FDA action level of 300 ug/kg, wet weight of total chlordane (Anderson et al. 1999). Results from the 1998 study for Union Pond are shown in Table 1.

Table 1. Total chlordane levels reported in fish tissue collected from Union Pond in 1998. (Anderson et. al. 1999).

Species	Fish Count	Fish Length			Total chlordane (wet weight basis)		
		Mean	Min.	Max.	ug/kg	ppm	MRL
Common Carp	3	523	493	548	516	0.516	12.7
Common Carp	3	504	498	515	387	0.387	105.3
Largemouth Bass	3	374	331	431	191	0.191	12.7

Although the data set was limited, as a precautionary measure, in June 1999, the Connecticut Department of Public Health (CT DPH) issued a 'do not eat' fish consumption advisory for Union Pond (Manchester, CT) due to concerns regarding chlordane levels. The advisory recommended not consuming bass, catfish and carp harvested from the pond. (It should be noted that catfish are not commonly present in Union Pond, and none were collected from the pond in 1998 by the

UConn researchers. The larger 1998 UConn chlordane fish tissue study did however include catfish collection at other sites. It is theorized that they may therefore have been accidentally included in the Union Pond advisory.)

A memo located in CT DEEP records indicates that an attempt was made to collect additional fish from Union Pond in 2008 for chlordane analysis. No additional records are available (e.g., resultant data if collection was successful) however.

The 'do not eat' fish consumption advisory for Union Pond (Manchester, CT) remains in place today. (The statewide consumption advisory for all inland freshwater bodies due to elevated mercury levels in fish tissue also applies to Union Pond.) Given chlordane has been banned from use for three decades now, in 2022, the CT DPH requested that CT DEEP collect new fish tissue data from Union Pond in order to inform an update to the chlordane-based 'do not eat' fish consumption advisory.

STUDY OBJECTIVES

The primary objective of the study was to evaluate chlordane levels in fish tissue collected from Union Pond in order to inform an update of the existing chlordane-based fish tissue consumption advisory.

The study further sought to determine whether chlordane tissue levels differed between predator species (e.g., Largemouth Bass) and bottom-dwelling, lower trophic level species (e.g., Common Carp, White Sucker).

Finally, the study sought to compare chlordane levels from fish collected from Union Pond, a waterbody located in an urbanized watershed, with the chlordane levels of fish collected from a nearby, undeveloped reference site.

STUDY AREA

The study area is contained within the Hockanum River watershed located in north-central Connecticut, east of the Connecticut River. (Figure 1) The Hockanum River flows out of Shenipsit Lake (which straddles Ellington, Tolland, and Vernon) and travels approximately 25 miles southwest from the towns of Vernon, north to Ellington, and then back south into Vernon*, Manchester, and East Hartford to join the Connecticut River. (*The name "Hockanum" is believed to be derived from the Native American (Podunk) name "Hoquaun" or "hook-shaped or crooked river", presumably because the river flows northwest out of Vernon into Ellington and then turns to flow southwest downstream back into Vernon. The river was also referred to as the "Mill River" and "Saw Mill River" in the 1600-1800s.)

Monitoring locations for this study include two impoundments of the Hockanum River:

1. **Union Pond** (Manchester, CT) – an impoundment located midway along the river's length and the location of the existing consumption advisory.
2. **Shenipsit Lake** (Vernon/Ellington/Tolland, CT) – an impoundment utilized for drinking water located in the river's undeveloped headwaters.

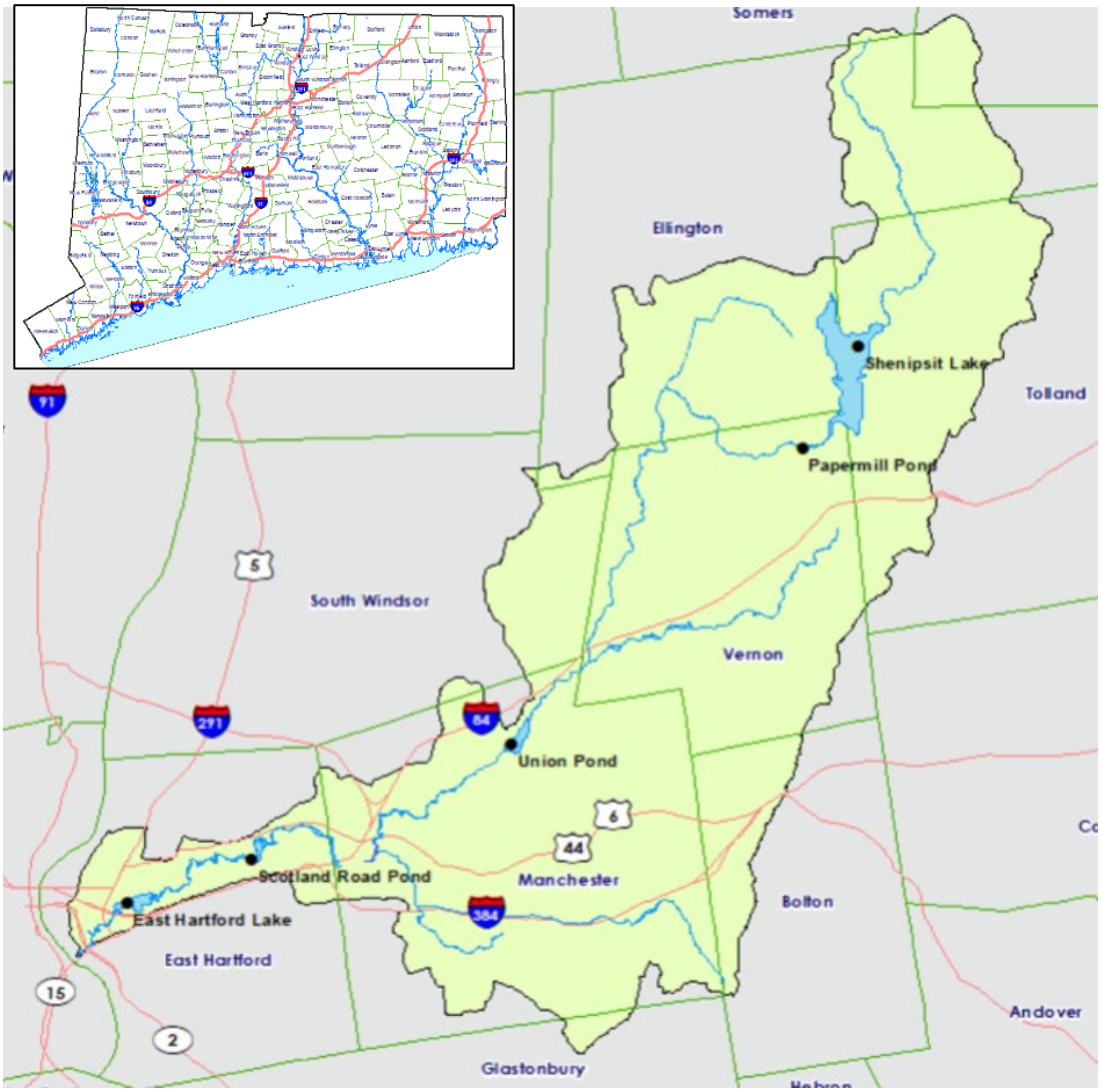


Figure 1. The Hockanum River watershed and associated impoundments. Major impoundments of the Hockanum River are noted and include (from upstream to downstream): Shenipsit Lake, Papermill Pond, Union Pond, Scotland Road Pond and East Hartford Lake.

Union Pond (Manchester, CT)

Union Pond is an approximately 20 acre impoundment of the Hockanum River formed by the Union Pond Dam just above Union Street in Manchester, CT (Figure 2). The pond is located immediately south of I-84 and is surrounded by high density residential and commercial land use.

Union Pond is a popular recreational fishery. A public boat launch is available at the town-owned Union Pond Park. Past electrofishing survey data (1996 and 2008) indicate that the most common species in the pond include Bluegill Sunfish, Yellow Perch, Black Crappie, Common Carp, Largemouth Bass, White Sucker, and Pumpkinseed. Individual Rock Bass, Chain Pickerel, Spottail Shiner, Fallfish, Golden Shiner and American Eel were also collected.

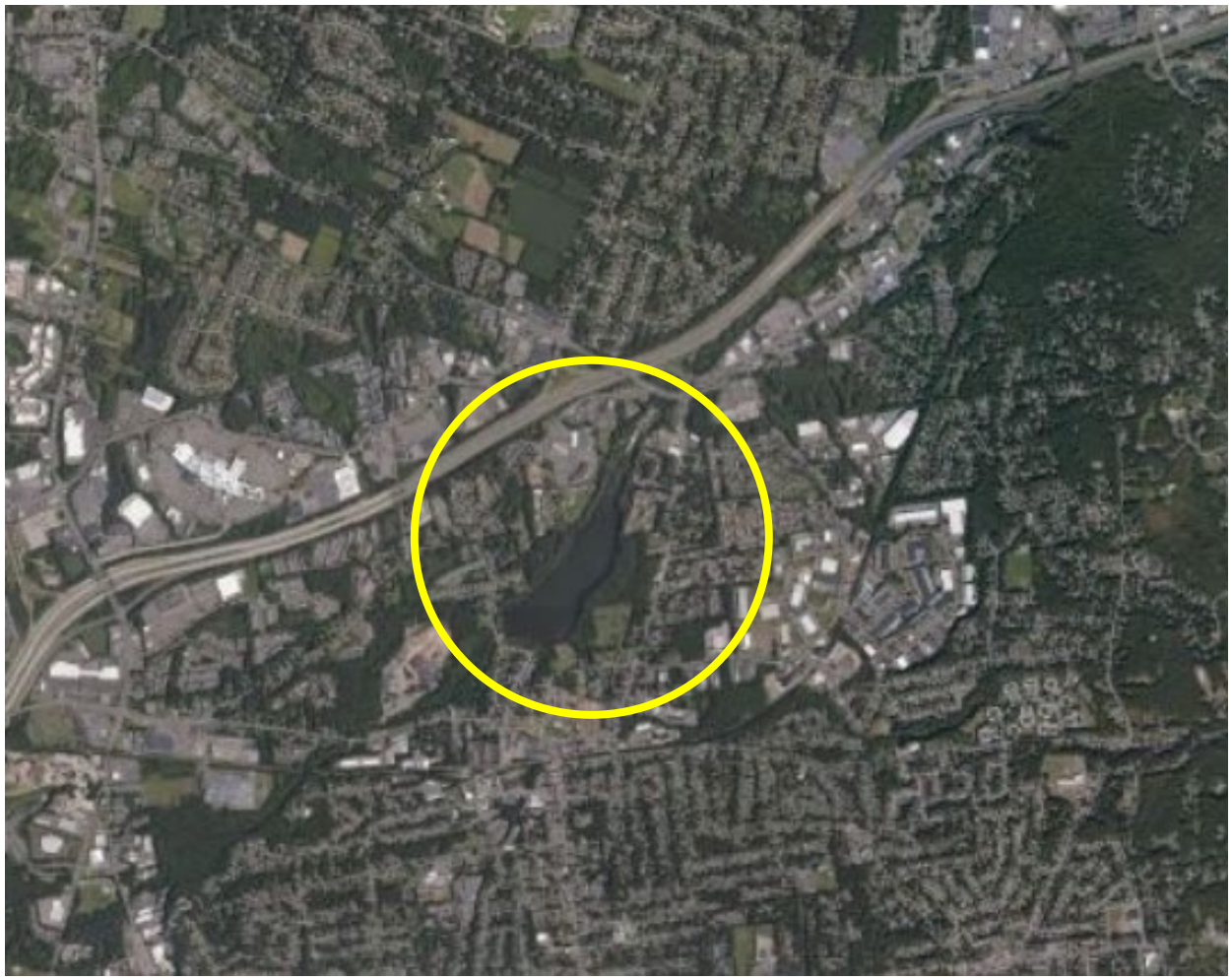


Figure 2. An aerial view of Union Pond (Manchester, CT). This image shows the urbanized nature of the surrounding watershed. The pond is highlighted by the yellow circle. Water flow enters the pond from the northeast and flows to the southwest.

Shenipsit Lake (Vernon/Tolland/Ellington, CT)

Shenipsit Lake is a 532 acre drinking water reservoir located in the towns of Ellington, Vernon and Tolland, CT (Figure 3). The lake is fed from the west by several small tributaries, (e.g., Sucker Brook and West Brook), and forms the Hockanum River at its outlet. (Although natural, a dam was in 1903 at the outlet to provide water to the mill community in the Rockville Section of Vernon.) Due to its position in the upper, relatively undeveloped portion of the Hockanum River watershed and the presence of a fish passage barrier (i.e., the Shenipsit Lake Dam), the waterbody provides a useful location for 'background' monitoring of chlordane levels (and PFAS levels) in fish tissue.

The lake is owned by a private water company and allows non-motorized boat access for fishing and recreation. There are also two designated shoreline fishing areas at the north end of the lake. Past electrofishing survey data (2015 and 2011) indicate that the most common species in the pond include Bluegill Sunfish, Largemouth Bass, Yellow Perch, White Perch, Pumpkinseed, Rock Bass, Golden Shiner, and White Sucker. Smallmouth Bass, Black Crappie, Chain Pickerel, Banded Killifish, Bridled Shiner, and stocked Brown and Rainbow Trout were also collected during surveys.

Figure 3. An aerial view of Shenipsit Lake (Vernon, Tolland, Ellington, CT). This image shows the relatively undeveloped nature of the surrounding watershed. A yellow oval is shown to highlight the location of the lake. Water enters the lake from several tributary streams located to the north and east and flows out of the lake to the southwest.

METHODS

Fish samples were collected by CT DEEP Water Monitoring and Assessment Program and CT DEEP Fisheries Division staff using an electrofishing boat and scoop nets. Fish were targeted for collection by species and size as outlined in Table 2. A collection goal of 15 bass, 15 carp and 15 suckers was set for each study site.

Table 2: Target Fish Species and Size Ranges

Trophic Category	Common Name	Scientific Name	Size Range (mm)	
			Min.	Max.
Predator	Smallmouth Bass	*Micropterus dolomieu*	300	-
	Largemouth Bass	*Micropterus salmoides*	300	-
Bottom-Feeder	White Sucker	*Catostomus commersonii*	150	-
	Common Carp	*Cyprinus carpio*	150	750

Upon capture, fish were transferred to the boat live well, which was filled with ambient water. Non-target species and/or fish outside of the size ranges noted in Table 2 were returned to the water unharmed. For those fish retained, the project lead identified the fish species and measured the total

length (to nearest millimeter, rounding down) of each fish captured, both of which were recorded by an assistant on the field chain of custody (field COC). Nitrile gloves were worn while handling specimens and changed in between specimens. Fish were dispatched, wrapped in aluminum foil, and placed into a zip-locking plastic bag. A label was placed inside the bag noting the unique fish ID, date of collection, source (i.e., waterbody), species, and total length. The fish ID was also recorded in permanent marker on the exterior of the bag. All bagged fish were placed on wet ice, in a closed cooler for the remainder of the field visit.

CT DEEP staff launch the electrofishing boat at the Union Pond Park in Manchester on June 23, 2022.

On the afternoon of the second field visit (i.e., Union Pond), 15 brown trout were collected from the CT DEEP Quinebaug Hatchery in Plainfield, CT to serve as 'field blanks'. Fish were dispatched, bagged, placed in a cooler on wet ice, and transported into the field. The cooler was brought into the field (i.e., on the boat). Once on the water, the fish were removed by the project lead from the cooler and placed into the live well. The field blank fish were then handled the same as the field-collected specimens (i.e., species identified, total length measured, recorded on field chain of custody, wrapped in aluminum foil, labelled, and bagged) and placed in a sample cooler for transport to the CT DEEP Laboratory in Windsor, CT .

Coolers full of fish were transported with the field COC immediately after the sampling event to the CT DEEP Laboratory in Windsor, CT. All fish were placed in laboratory freezers within less than 8 hours of collection. Each individual fish was logged into the Fish Contaminant Monitoring Project electronic sample log within 24 hours. The field chain of custodies were stored on the exterior of the freezer where the bagged fish were located.

Fish were then assigned to a five-fish composite sample group such that each sample contained fish of the same species and of similar size. The smallest fish in each composite group was no less than 75% of the length of the longest fish in that group. The individual fish assigned to a given composite group were then placed into a second bag which was labelled with a unique composite ID, date of collection, waterbody, species, fish count, and list of individual fish IDs. The second bag

was securely sealed and returned to the freezer until transport to the analytical lab. (The initial bag that the individual fish were placed in while in the field was not opened during this process.)

All fish species other than Common Carp, remained frozen as whole fish until transport to the analytical laboratory. The analytical laboratory requested that CT DEEP fillet carp samples prior to submission. Frozen whole carp were partially thawed in aluminum foil covered fume hoods and then individually scaled and filleted according to standard CT DEEP procedures. Fillets were individually labelled, bagged and returned to the freezer. The remaining fish carcass was discarded.

On the day of transport, a UConn CESE chain of custody (COC) was prepared (Appendix A) which included each unique composite ID as the sample ID and noted how many individual fish were being submitted for inclusion in each composite noted on the COC. A separate chain of custody was prepared for each monitoring location. Bagged groups of frozen fish samples (whole fish and/or fillets) were placed on wet ice and driven by CTDEEP staff to the University of Connecticut's Center for Environmental Science and Engineering (UConn CESE) laboratory in Mansfield, CT (approximately 40 minutes away).

Upon receipt, UConn CESE staff verified the presence and suitable temperature of all samples. Both the field and laboratory chain of custodies were signed by both the UConn CESE staff receiving the sample and the CT DEEP staff relinquishing the sample. An electronic copy of the signed COCs was placed in the project folder upon return to the CT DEEP Field Laboratory. The original field COCs were retained by CT DEEP and placed in the hard-copy project folder at the CT DEEP Windsor Laboratory.

Above: A partially thawed, scaled Common Carp is in the process of being filleted for submission to the analytical lab. The package in the upper right contains the labelled left-side fillet. The right-side fillet has been removed (top center) and will be wrapped in foil and placed in the labelled bag on the left. The remaining fish carcass (photo bottom) will be discarded.

After receipt, whole fish were filleted and homogenized by UConn CESE staff according to standard laboratory procedures. Sample analysis was performed according to *Standard Operating*

*Procedure for the Analysis of Pesticides in Tissue or Sediment by QuEChERS and GC-MS/MS (*UConn CESE SOP ORG-018-01). Results were reported electronically on a wet weight basis in ng/g. (Fish were also analyzed for PFAS; these data will be reported in a separate project report.)

RESULTS

Sample Collection

Standard Agency field safety and boat electrofishing protocols were followed at both sites. The project lead was present for both sampling efforts and confirmed that the study sampling and analysis plan was correctly followed.

Field conditions at the time of both sample collections were normal. No precipitation was documented during the sampling events and flows were comparable to median daily historic values at the time of sampling (Figure 4). Rainfall did occur within 24 hours prior to sampling Union Pond but did not impact field sampling efforts and is not expected to impact study results.

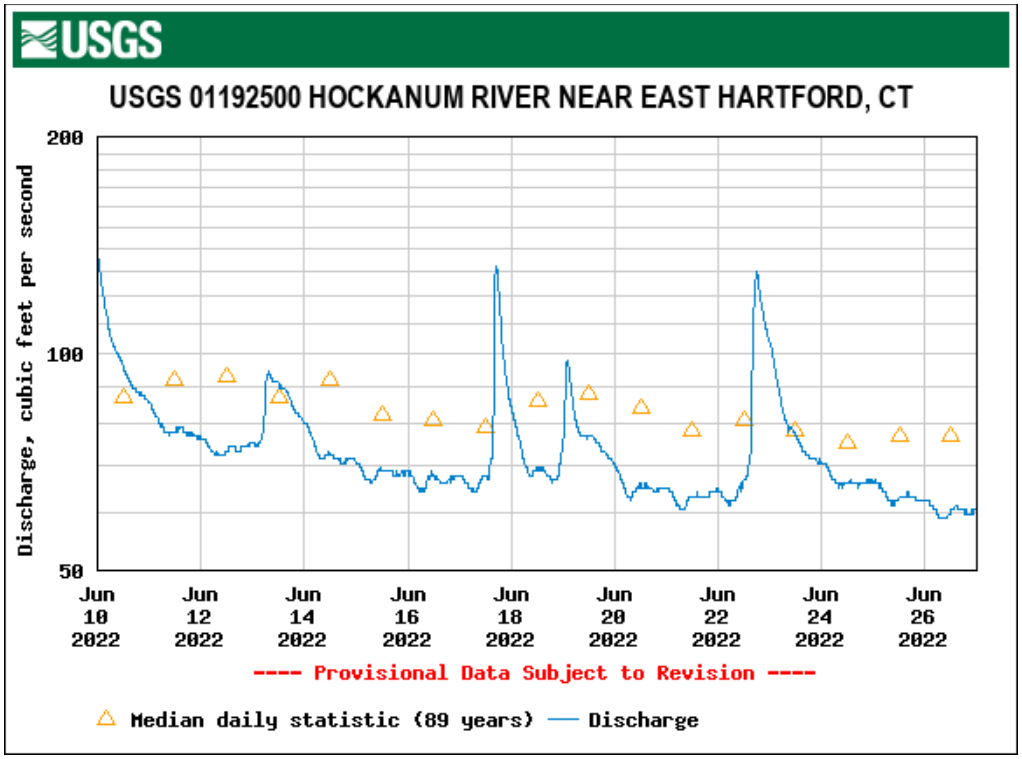


Figure 4. Hockanum River discharge at the USGS gaging station in East Hartford, CT during the time period surrounding the two sampling events.

Shenipsit Lake was electrofished on the evening of June 13, 2022. (Although motorized boats are generally not permitted on the lake, permission was granted by the Connecticut Water Company to electrofish the lake. The water company outlined required boat decontamination procedures which were adhered to by Agency staff prior to launching.) The boat was launched from the water company owned launch just upstream of the dam and the full perimeter of the lake was electrofished. A significant number of anglers were observed along the northern shoreline during sample collection. In total 62 fish were retained for analysis, including 15 largemouth bass. No white suckers, catfish or common carp were observed during electrofishing. Therefore, 2 Brown Bullhead were collected as substitute species and retained for analysis; these were the only bottom-

feeding fish that the crew was able to collect. (Catfish and bullheads are known to be difficult to capture using electrofishing techniques.) In addition, given the significant number of individuals fishing the waterbody, 15 Pumpkinseed, 15 Bluegill, and 15 Yellow Perch were also retained for analysis.

Union Pond was electrofished on the evening of June 23, 2022. The electrofishing boat was launched from the public launch at Union Pond Park in Manchester and the lake perimeter was sampled for fish. In total 45 fish were retained for analysis including 15 largemouth bass, 15 common carp, and 15 white suckers. Individuals were observed fishing during sample collection, however the general number of anglers observed was lower than that observed at Shenipsit Lake previously.

Table 3 provides a summary of the individual fish collected from each sampling location and the composites submitted for analysis.

Table 3. Summary of fish samples submitted for analysis.

Waterbody	Trophic Category	Species	Composite ID	Fish Count	Total Length (mm)		
					Avg.	Min.	Max.
Shenipsit Lake (Station #14449)	Predator	Largemouth Bass	14449-LMB-1	5	346	303	381
			14449-LMB-2	5	356	321	420
			14449-LMB-3	5	356	295	387
	Bottom-Feeder	Brown Bullhead	14449-BB-1	2	382	375	388
	Misc. Gamefish	Pumpkinseed	14449-PS-1	5	219	207	230
			14449-PS-2	5	214	195	225
			14449-PS-3	5	192	183	212
		Bluegill	14449-BG-1	5	216	206	225
			14449-BG-2	5	210	210	225
			14449-BG-3	5	204	204	231
		Yellow Perch	11449-YP-1	5	185	167	205
			11449-YP-2	5	223	218	235
			11449-YP-2	5	269	251	291
Union Pond (Station #16186)	Predator	Largemouth Bass	16186-LMB-1	1	480	480	480
			16186-LMB-2	5	350	323	368
			16186-LMB-3	5	307	296	315
			16186-LMB-4	4	264	232	299
	Bottom-Feeder	White Sucker	16186-WS-1	5	422	373	479
			16186-WS-2	5	394	374	432
			16186-WS-3	5	392	372	416
		Common Carp	16186-CA-1(L)	5	563	451	605
			16186-CA-2(L)	5	664	642	690
			16186-CA-3(L)	5	621	606	640

As noted above, Largemouth Bass were successfully collected at both locations. The target of 15 fish was successfully collected from each waterbody, however at both locations fish shorter than the

target length of 300 mm were retained (n=5 at Union Pond and n=1 at Shenipsit Lake) in order to achieve the target sample size.

Largemouth Bass collected from Union Pond in the 1998 study (n=3) ranged from 331-431 mm, with an average size of 374 mm (Figure 5) . Bass collected from Union Pond ranged in size from 232 mm to 480 mm in total length, with an average size of 321.5 mm. Bass collected from Shenipsit Lake were slightly larger on average, ranging in size from 295 mm to 420 mm in total length, with an average size of 352.7 mm. Due to compositing size rules, one fish collected from Union Pond was analyzed as a discrete sample. Therefore, four sample results are reported for Union Pond while three composite samples are reported for Shenipsit Lake.

Common Carp collected in the 1998 study (n=6) ranged in size from 493 mm to 548 mm, with an average size of 513.5 mm. Common Carp collected from Union Pond in 2022 were within the targeted size ranges described in Table 2, but larger than those in the historic study (Figure 5). Individual fish ranged in size from 451 mm to 690 mm, with an average total length of 616.2 mm. Common Carp were not observed in Shenipsit Lake, therefore no Shenipsit Lake fish are available for comparison.

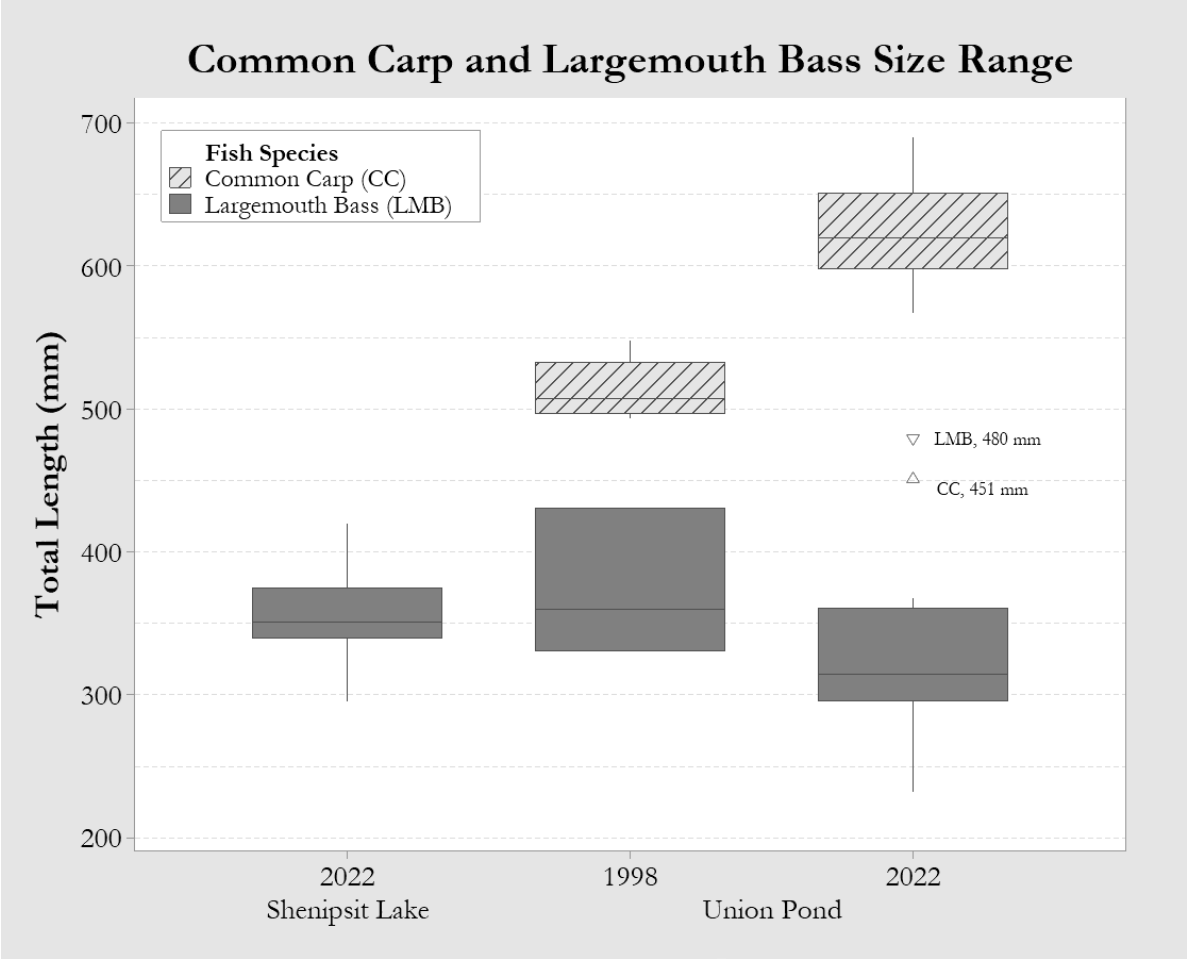


Figure 5. Boxplot depicting the range in size of Common Carp and Largemouth Bass collected during 1998 and 2022 from the two study sites. Outliers are shown as triangles; the direction of the triangle indicates the associated boxplot.

White Sucker collected from Union Pond were also within the targeted size ranges described in Table 2. White Sucker were not included in the 1998 study. White Sucker were also not observed in Shenipsit Lake, therefore no Shenipsit Lake fish are available for comparison.

Due to a lack of a White Suckers and Common Carp in Shenipsit Lake, Brown Bullhead were retained for analysis. Brown Bullhead collected from Shenipsit Lake (n=2) averaged 382 mm total length. These bullheads are intended to represent 'background' chlordane levels in bottom-dwelling species in the watershed, but given the small sample size and species difference, the data should be interpreted with caution.

Detailed information about individual fish collected from each waterbody is available in Appendix B-1 (Shenipsit Lake) and Appendix B-2 (Union Pond).

Sample Analysis

All Shenipsit Lake fish samples were delivered to UConn on June 22, 2022 (9 days post-collection). Hatchery field blanks and Union Pond bass and white sucker samples were delivered to UConn on June 29, 2022 (6 days post-collection). UConn CESE requested that DEEP fillet Common Carp samples prior to submission; due to scheduling limitations carp were not able to be filleted until September 1, 2022. Filleted carp were delivered to UConn on September 2, 2022 (82 days post-collection).

All samples were prepared by UConn CESE for analysis on October 4, 2022 and analyzed on October 14, 2022 for cis(alpha)-chlordane, trans(gamma)-chlordane, and oxychlordane. A copy of the laboratory results is provided in Appendix C.

Union Pond Fish Tissue Results

Chlordane was detected in all 10 samples of fish tissue collected from Union Pond. Tissue sample analysis results are summarized in Table 4 and Figure 6.

Chlordane was detected in all Largemouth Bass samples collected from Union Pond (Figure 6). Cis(alpha)-chlordane and trans(gamma)-chlordane were detected in all samples. Largemouth Bass total chlordane concentrations ranged from 2.855 ng/g to 5.92 ng/g. Oxychlordane was detected in only 1 of the 4 bass samples at a value of 2.44 ng/g; all other samples were below the laboratory reporting limit of 0.17 ng/g.

Chlordane was also detected in all samples of bottom-feeding species collected from Union Pond (e.g., Common Carp and White Sucker), at slightly higher concentration than those observed in the predator species (i.e., Largemouth Bass). Cis(alpha)-chlordane and trans(gamma)-chlordane were detected in all bottom-dwelling samples. Common Carp total chlordane values ranged from 7.895 ng/g to 23.21 ng/g. Oxychlordane was detected in 2 out of 3 carp samples, with a maximum detected value of 2.97 ng/g. White sucker values were similar, ranging from 8.905 ng/g to 15.99 ng/g total chlordane in the edible tissue. Oxychlordane was detected in 2 out of 3 white sucker samples, with a maximum detected concentration of 3.53 ng/g.

Reference Site Samples

Results of the composite samples collected from Shenipsit Lake are summarized in Table 5, and Figure 7.

Table 4. Union Pond fish tissue chlordane analysis results summary. Results are shown in ng/g (ppb), on a wet weight basis. ND values were replaced with 0.5*RL for calculation of average values and total chlordane values.

Trophic Level	Species	n	cis(alpha)-chlordane			trans(gamma)-chlordane			oxychlordane			Total Chlordane*		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Predator / Gamefish	Largemouth Bass	3	1.48	1.93	1.70	1.12	1.74	1.49	ND	2.44	0.67	2.86	5.92	3.86
Bottom-Dweller	Common Carp	3	4.03	10.60	7.59	3.78	10.46	7.74	ND	2.97	1.74	7.90	23.21	17.07
	White Sucker	3	4.64	6.30	5.66	4.18	6.16	5.44	ND	3.53	2.08	8.91	15.99	13.18

Table 5. Shenipsit Lake fish tissue chlordane analysis results summary. Results are shown in ng/g (ppb), on a wet weight basis. ND values were replaced with 0.5*RL for calculation of average values and total chlordane values.

Trophic Level	Species	n	cis(alpha)-chlordane			trans(gamma)-chlordane			oxychlordane			Total Chlordane*		
			Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
Predator / Gamefish	Largemouth Bass	3	ND	0.84	0.28	ND	ND	ND	ND	ND	ND	0.18	0.97	0.44
	Pumpkinseed	3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	Yellow Perch	3	ND	1.30	0.43	ND	0.46	0.15	ND	ND	ND	0.18	1.43	0.73
	Bluegill	3	ND	ND	ND	ND	0.79	0.26	ND	ND	ND	0.18	0.93	0.43
Bottom-Dweller	Brown Bullhead	1	1.36	1.36	1.36	1.15	1.15	1.15	ND	ND	ND	2.60	2.60	2.60

Table 4 and Table 5 Notes:

- *When detections occurred in one or more analyte, non-detect values were replaced with 0.5*RL for averaging purposes and total chlordane calculations. Reporting limits were as follows: oxychlordane – 0.17 ng/g, trans(gamma)-chlordane – 0.10 ng/g, cis(alpha)-chlordane – 0.08 ng/g
- All samples noted are 5-fish composites with the exception of the Shenipsit Lake brown bullhead sample (2-fish composite) and two of the Union Pond Largemouth Bass samples (1 discrete sample, and 1 4-fish composite).

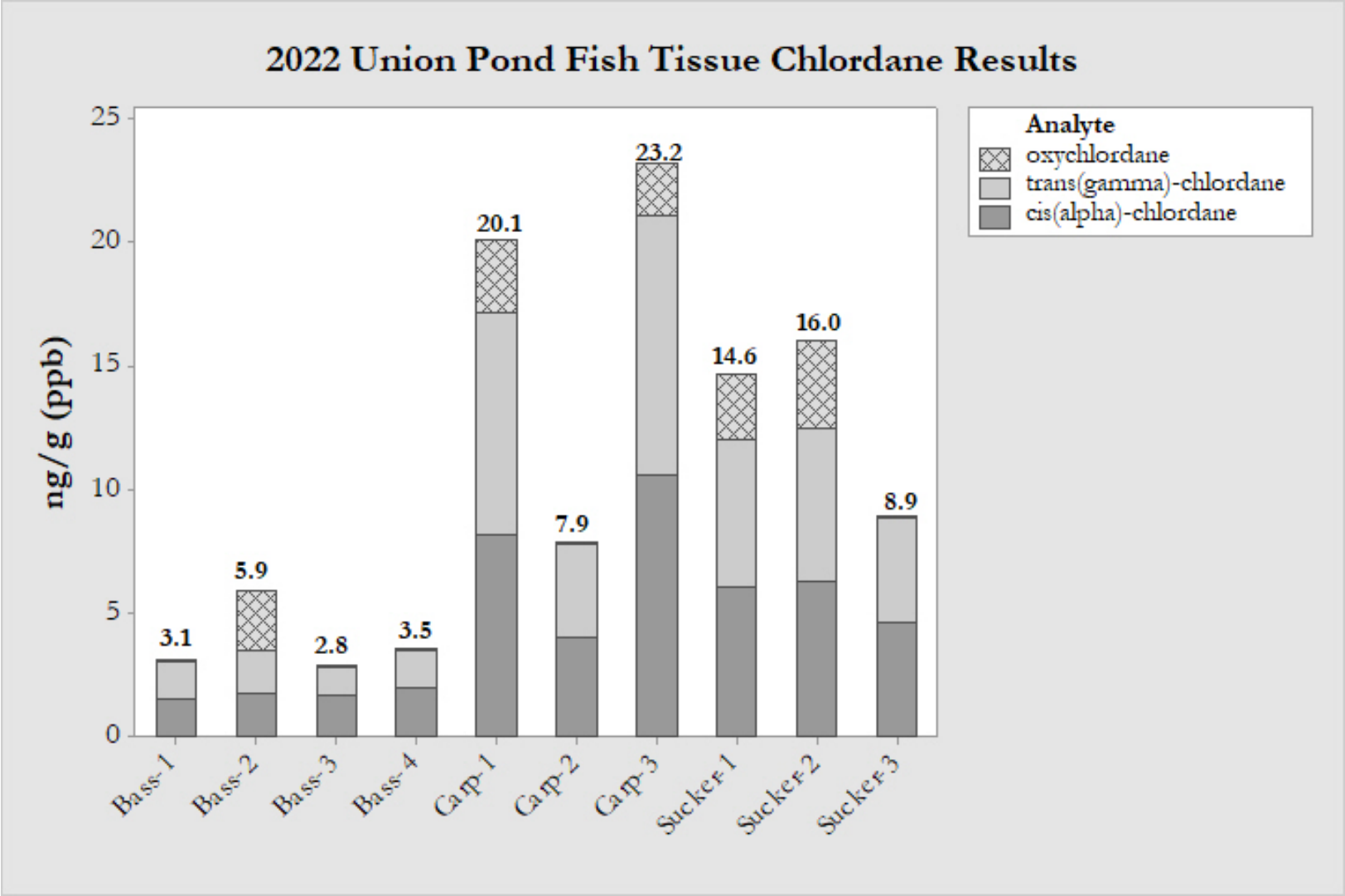


Figure 6. 2022 Union Pond fish tissue chlordane analysis results. Results are displayed in ng/g (ppb) on a wet weight basis. Non-detect values were replaced with 0.5*RL. The value at the top of each bar represents total chlordane in the sample (ng/g).

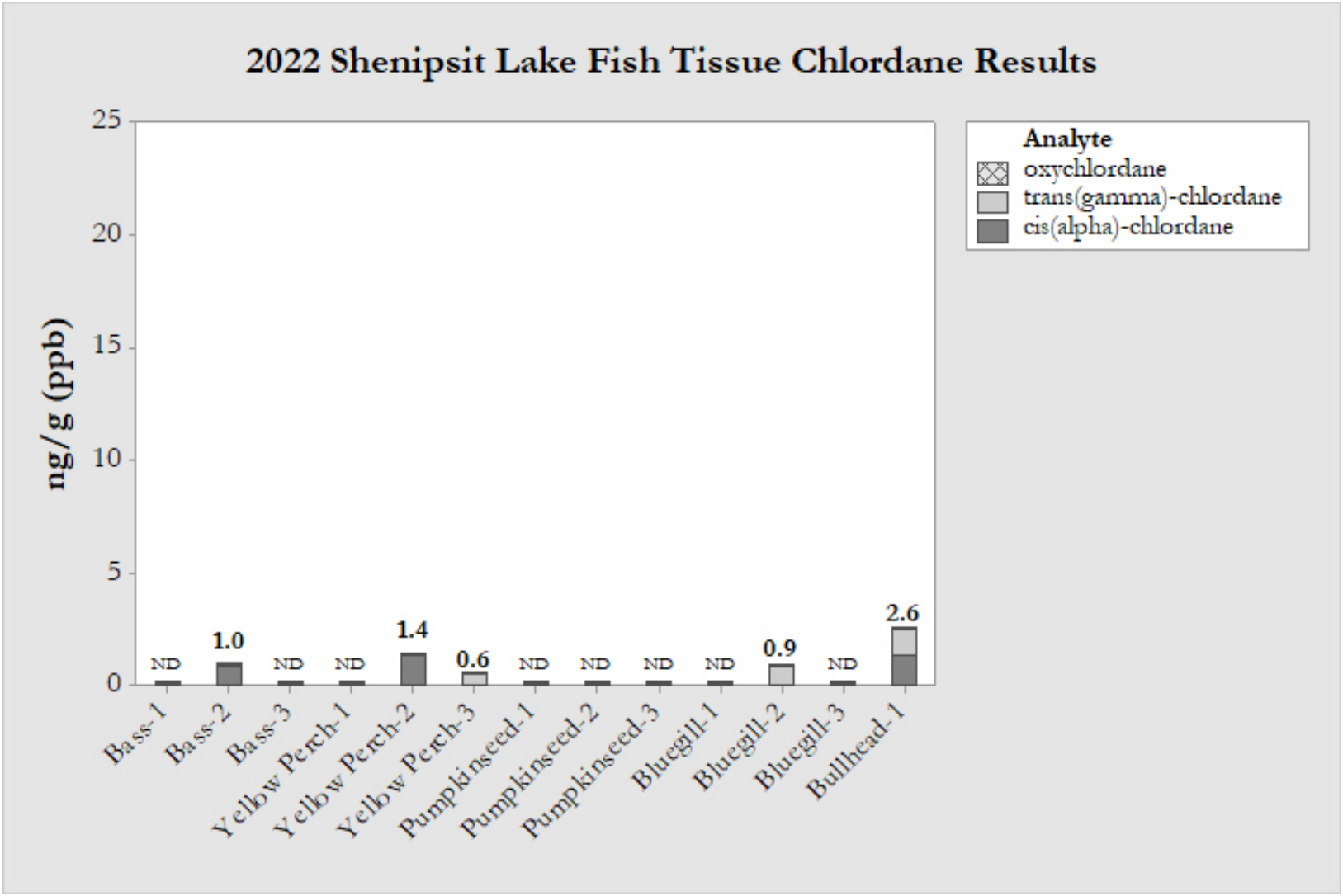


Figure 7. 2022 Shenipsit Lake fish tissue chlordane analysis results. Results are displayed in ng/g (ppb) on a wet weight basis. Non-detect values were replaced with 0.5*RL. The value at the top of each bar represents total chlordane in the sample (ng/g); if the sample was non-detect for all three analytes, it is labelled "ND".

Approximately 2/3 of the Shenipsit Lake samples (8 out of 13, 61.5%) were non-detect for all three forms of chlordane analyzed. The average concentration in those samples with detections was a 1.30 ng/g. Oxychlordane was not detected in any of the Shenipsit Lake fish tissue samples.

Chlordane was detected in only 1 out of 3 of the Largemouth Bass samples collected from Shenipsit Lake (Figure 7). Only cis(alpha)-chlordane was detected in the bass sample; trans(gamma)-chlordane and oxychlordane were not detected in any largemouth bass collected from Shenipsit Lake. Chlordane was also detected in 2 Yellow Perch and 1 Bluegill sample. Pumpkinseed samples were non-detect for all forms of chlordane analyzed.

The brown bullhead composite had the highest total chlordane concentration (2.595 ng/g) of all samples collected from Shenipsit Lake. The bullhead sample was the only composite from Lake Shenipsit that had detections of both cis(alpha)- and trans(gamma)-chlordane.

Quality Control Samples

The hatchery-sourced Brown Trout were all non-detect for oxychlordane, trans(gamma)-chlordane, and cis(alpha)-chlordane. These results indicate that cross-contamination during field collection, sample handling, and/or laboratory analysis are not likely sources of chlordane in the reported data.

CONCLUSIONS

The water quality of Union Pond is currently impaired for fish consumption due to historically elevated levels of total chlordane (CT DEEP 2020). Based on these historic data, the Connecticut Department of Public Health has issued and maintained a 'Do Not Eat' fish consumption advisory for bass, catfish and carp collected from the pond (CT DPH 2020).

The results of this study suggest that total chlordane levels in fish tissue collected from Union Pond have decreased several orders of magnitude since 1998 (Figure 8). Total chlordane levels measured in Largemouth Bass and Common Carp collected from the pond in 2022 averaged 3 ppb and 15 ppb respectively, compared to 191 ppb (0.191 ppm) and 451 ppb (0.451 ppm) in the 1998 study.

The Shenipsit Lake fish tissue results (Figure 7) reinforce that in the absence of significant anthropogenic sources (e.g., pesticide contamination) fish tissue collected from Connecticut waterbodies should have extremely low, if any, amounts of chlordane present.

Although total chlordane levels in Union Pond have decreased, they do still remain elevated above background values. Average 2022 total chlordane in bass collected from Union Pond was approximately six times higher than the average total chlordane level in bass collected from Shenipsit Lake during 2022 (Figure 9).

All 2022 Union Pond total chlordane fish tissue values, regardless of trophic level or species, were well below the 0.3 ppm (300 ppb) FDA action level for chlordane in fish (edible portion) (US FDA 2000) (Figure 6, Figure 9). EPA screening values for recreational fishermen and for subsistence fisherman are 144 ppb and 14 ppb total chlordane, respectively (U.S. EPA 2000b). The majority of bottom-dwelling species samples (66%) exceeded the 14 ppb SV for subsistence fisherman (Figure 9). The maximum Common Carp total chlordane value was 23.21 ppb and average total chlordane concentration for Common Carp was 17 ppb. Total chlordane levels in bottom feeder fish species collected from Union Pond may therefore warrant further review.

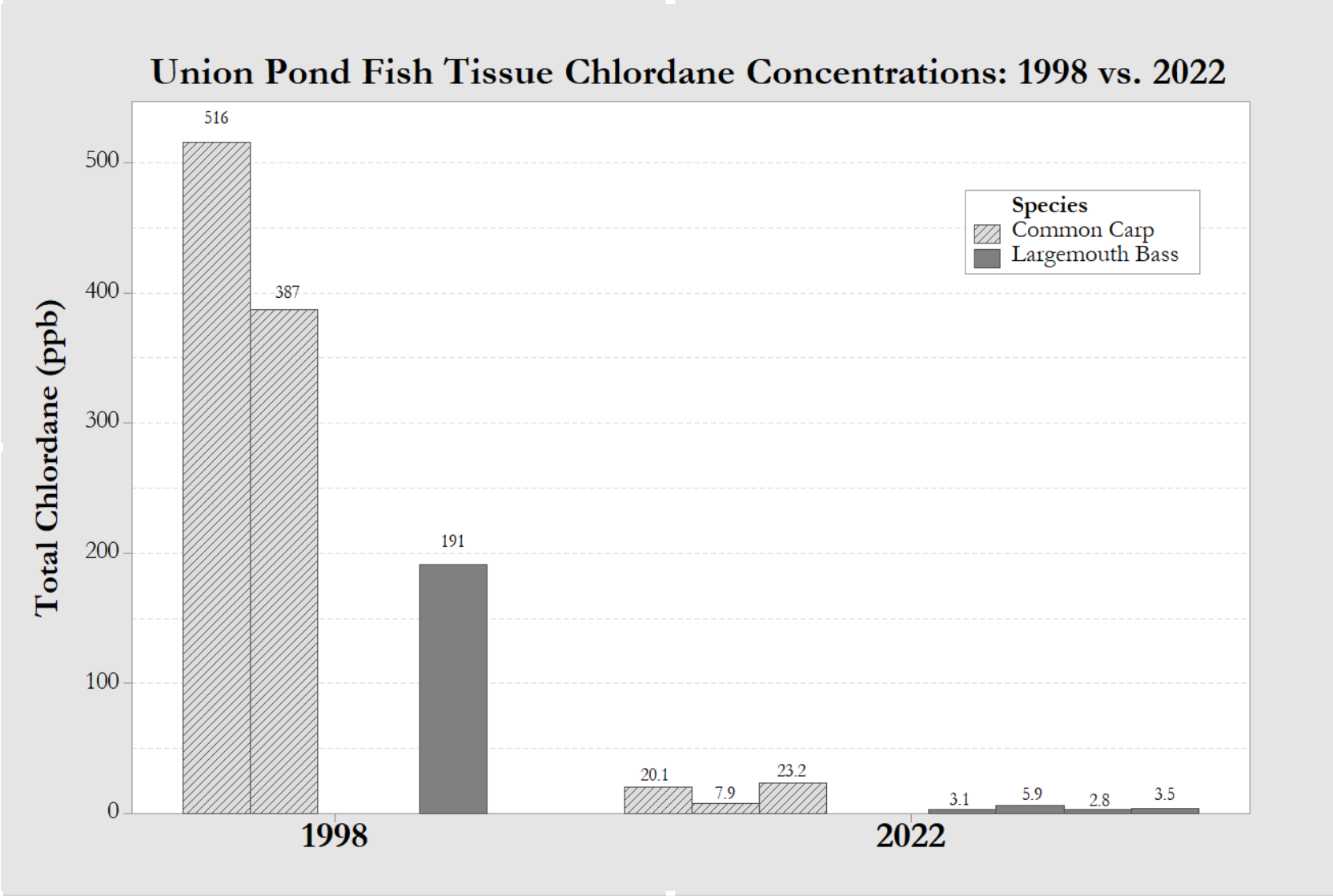


Figure 8. 1998 and 2022 Union Pond fish tissue chlordane analysis results. Results are displayed in ng/g (ppb) on a wet weight basis.

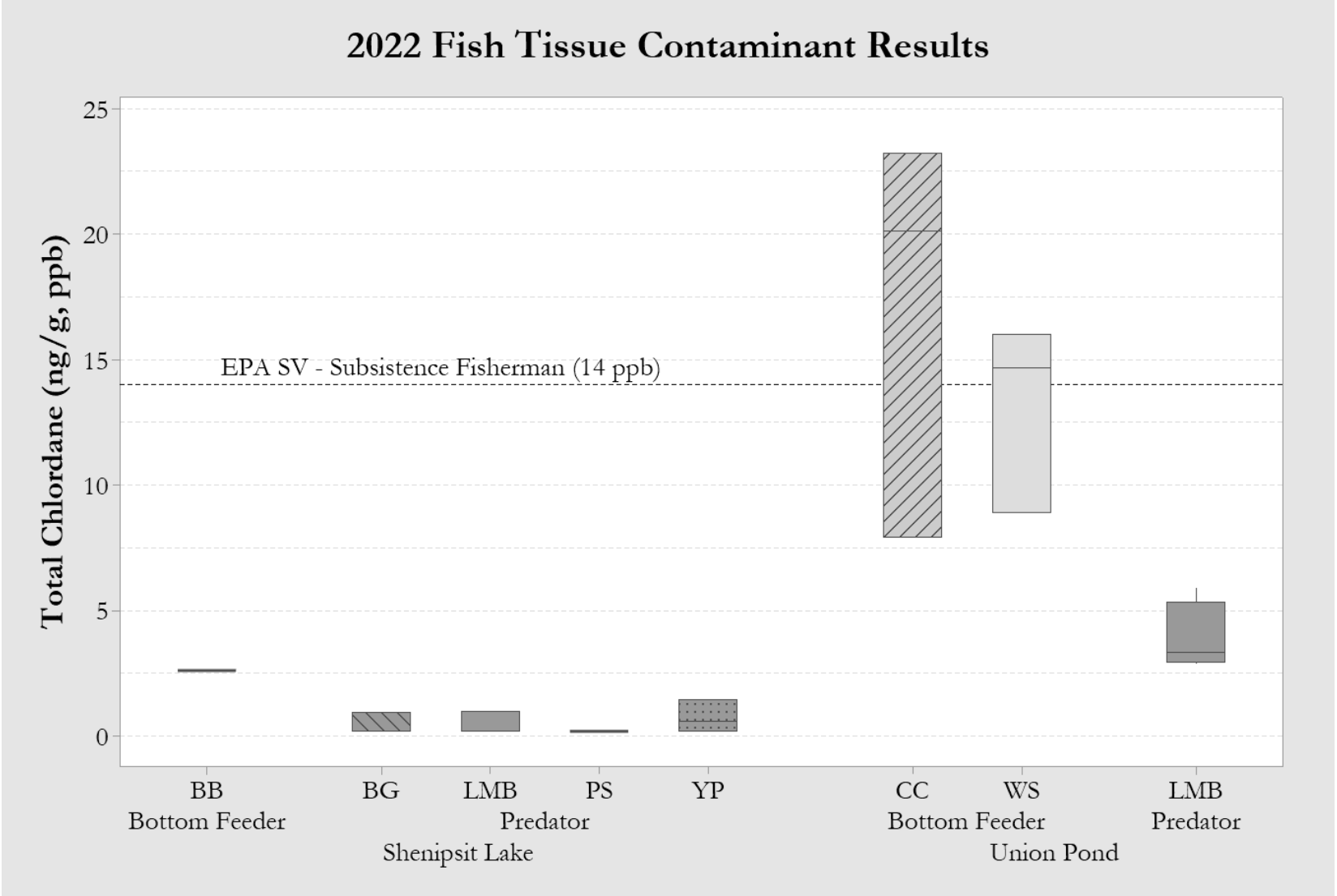


Figure 9. Comparison of 2022 total chlordane levels in fish collected from Shenipsit Lake and Union Pond. The dashed line represents the EPA screening value for subsistence fisherman of 14 ppb. Species codes are as follows: BB = Brown Bullhead, BG = Bluegill, LMB = Largemouth Bass, PS = Pumpkinseed, YP = Yellow Perch, CC = Common Carp, and WS = White Sucker.

ACKNOWLEDGMENTS

This study would not have been possible without the partnership of the Connecticut Department of Energy and Environmental Protection (CT DEEP), University of Connecticut Center for Environmental Sciences and Engineering (UConn CESE), Connecticut Water Company, Town of Manchester, and Connecticut Department of Public Health (CT DPH). The following individuals in particular, made substantial contributions to the success of this project:

Meghan Lally (CT DEEP Water Planning and Management) served as project manager for this study. She is the lead author of the project sampling and analysis plan (SAP), served as field crew supervisor, oversaw sample handling and processing at the CT DEEP Windsor Field Laboratory , and conducted the data review and analysis for this study.

Sampling and analysis plan (SAP) development support and review was provided by **Pete Aarrestad** (CT DEEP Fisheries), **Mike Beauchene** (CT DEEP Fisheries), **Chris McDowell** (CT DEEP Fisheries), **Brian Eltz** (CT DEEP Fisheries), **Chris Bellucci** (CT DEEP Water Planning and Management), **Mary Becker** (CT DEEP Water Planning and Management), **Traci Iott** (CT DEEP Water Planning and Management), and **Sharee Rusnak** (CT DPH Environmental Health).

Field work was overseen by support was provided by **Mike Beauchene**, who captained electrofishing efforts on both Union Pond and Shenipsit Lake, as well as the following CT DEEP Water Planning and Management Division staff: **Walter Tokarz, Melissa Czarnowksi, Tim Strzepa*, Chris Goss*,** and **Juliana Holcomb*.**

Shenipsit Lake boat ramp access coordination was provided by L**auren Bergman, Nick Meder** and **Paul Andrews** of the **Connecticut Water Company**.

Union Pond Park boat ramp access coordination was provided by **Steve Stephanous** and **Tim Bockus** of the **Town of Manchester.**

Tracy Lizotte, CT DEEP Water Monitoring Lab Coordinator, provided equipment acquisition support, field crew scheduling, oversight of sample storage and delivery logistic support. **Tim Strzepa** assisted in the laboratory with fish scaling and filleting.

Ellie Fiorentino (CT DEEP Water Planning and Management *), **Ansel Aarrestad** (CT DEEP Water Planning and Management), and **Tracy Lizotte** assisted with the delivery of fish tissue samples to the analytical laboratory.

Tom Chairvolotti of the CT DEEP Fisheries Division provided the necessary hatchery-raised trout for field blanks.

Laboratory analysis and related support services were provided by **Chris Perkins, Anthony Provatas, Steph Kexel,** and **Snieguole Stapcinskaite** at the University of Connecticut Center for Environmental Sciences and Engineering.

Laboratory contracting support was provide by **Anupam Pertab** (CT DEEP Office of Legal Counsel), **Mary Becker** (CT DEEP WPMD), **Laurie Valente** (CT DEEP Bureau of Central Services), and **Chris Perkins** (UConn CESE)

**Denotes a 2022 WPMD seasonal resource employee*

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Appendix A. Chain of Custody Forms

CESE CHAIN OF CUSTODY

Center for Environmental Sciences and Engineering
University of Connecticut
3107 Horsebarn Hill Road; U-4210 Storrs, Ct 06269-5210
Phone: (860) 486-4015 Fax: (860) 486-5488

☐ ORIGINAL

Turn Around Time in Working Days (Circle one)			
Standard	Rush	Priority	Other or Contractual
28 Day	14 Day	7 Day	
Regular Price	25% Surcharge	50% Surcharge	Discounts or Surcharges may apply

Reviewed By:

Company	CT DEEP Bureau of Water Management	Project Contact	Meghan Lally	Billing Contact	
Project	**2022 Hockanum River PFAS Study: Union Pond Fish Tissue Samples**	Phone/Fax	860-424-3061	Phone	
Address	79 Elm Street	E-Mail	Please email data to DEEP.MonitoringData@ct.gov	E-Mail	
City	Hartford State CT Zip 06106	Reporting Request	Please email data to DEEP.MonitoringData@ct.gov	Purchase Order/ Reference Number	

SAMPLE TRANSFER (sign below)

1. Relinquished By: (print/sign) TRACY LABONTE — Date: 6/29/22 Time: 1115
2. Received By: (print/sign) Perkins — Date: 6/29/22 Time: 1115
3. Relinquished By: (print/sign) — Date: Time:
4. Received By: (print/sign) — Date: Time:

Storage Location: Metals: Organics: Nutrients: VOC's Remediation: Other:

	Field Number	CESE ID	Collection Date	Collection Time	Matrix (Key Below)	Preservation (Key Below)	Number of Containers	Comments	Test Parameter or CAS Number: PFAS - See reverse	Chlordane - see reverse	% Moisture	% Lipids
1	✓ 16186-WS-1	22O140-001	06/15/22	18:00	T	F	1	1 bag containing 5 fish for compositing	X	X	X	X
2	✓ 16186-WS-2	-002	06/15/22	18:00	T	F	1	1 bag containing 5 fish for compositing	X	X	X	X
3	✓ 16186-WS-3	-003	06/15/22	18:00	T	F	1	1 bag containing 5 fish for compositing	X	X	X	X
4	✓ 16186-LMB-1	-004	06/15/22	18:00	T	F	1	1 bag containing 1 fish for individual analysis	X	X	X	X
5	✓ 16186-LMB-2	-005	06/15/22	18:00	T	F	1	1 bag containing 5 fish for compositing	X	X	X	X
6	✓ 16186-LMB-3	-006	06/15/22	18:00	T	F	1	1 bag containing 5 fish for compositing	X	X	X	X
7	✓ 16186-LMB-4	22O140-007	06/15/22	18:00	T	F	1	1 bag containing 4 fish for compositing	X	X	X	X
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Please Circle One: NON-HAZARDOUS HAZARDOUS HIGHLY CONTAMINATED UNKNOWN

******If needs to be preserved** add P next to preservation code ********

In comments area: designate MS/MSD sample for organics, if needs filtering, why hazardous, known sample matrix and analyte levels, or any additional pertinent information

Matrix: DW = Drinking Water, GW = Ground Water, WW = Waste Water, SW = Sea Water, L = Liquid, S = Solid, SO = Soil, A = Air, F = Filter, T = Biological Tissue, O = Other

Preservation: R = Refrigerate (4°C), F= Freeze, N = Nitric Acid, H = Hydrochloric Acid, O = Other M = Methanol, MC = Methylene Chloride, SB = Sodium Bisulfite, C = Chloroform, S = Sulfuric Acid

CESE CHAIN OF CUSTODY

Center for Environmental Sciences and Engineering
University of Connecticut
3107 Horsebarn Hill Road; U-4210 Storrs, Ct 06269-5210
Phone: (860) 486-4015 Fax: (860) 486-5488

Turn Around Time in Working Days (Circle one)			
Standard	Rush	Priority	Other or Contractual
28 Day	14 Day	7 Day	
Regular Price	25% Surcharge	50% Surcharge	Discounts or Surcharges may apply

Reviewed By:

Company	CT DEEP Bureau of Water Management	Project Contact	Meghan Lally	Billing Contact	
Project	2022 Hockanum River PFAS Study: Union Pond Fish Tissue Samples	Phone/Fax	860-424-3061	Phone	
Address	79 Elm Street	E-Mail	Please email data to DEEP.MonitoringData@ct.gov	E-Mail	
City	Hartford State CT Zip 06106	Reporting Request	Please email data to DEEP.MonitoringData@ct.gov	Purchase Order/ Reference Number	

SAMPLE TRANSFER (sign below)

1. Relinquished By: (print/sign) Meghan Lally M. Lally	Date: 09/02/22 Time: 09:19	3. Relinquished By: (print/sign)	Date: Time:
2. Received By: (print/sign)	Date: 9/2/22 Time: 0930	4. Received By: (print/sign)	Date: Time:

Storage Location: Metals: Organics: Nutrients: VOC's Remediation: Other:

	Field Number	CESE ID	Collection Date	Collection Time	Matrix (Key Below)	Preservation (Key Below)	Number of Containers	Comments	Test Parameter or CAS Number: PFAS - See reverse	Chlordane - see reverse	% Moisture	% Lipids
1	16186-CA-1 (L)	220252-001	06/15/22	18:00	T	F	1	1 bag containing 5 left-side fillets for compositing	X	X	X	X
2	16186-CA-2 (L)	↓ -002	06/15/22	18:00	T	F	1	1 bag containing 5 left-side fillets for compositing	X	X	X	X
3	16186-CA-3 (L)	220252-003	06/15/22	18:00	T	F	1	1 bag containing 5 left-side fillets for compositing	X	X	X	X
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Please Circle One: NON-HAZARDOUS HAZARDOUS HIGHLY CONTAMINATED UNKNOWN

******If needs to be preserved add P next to preservation code ********

In comments area: designate MS/MSD sample for organics, if needs filtering, why hazardous, known sample matrix and analyte levels, or any additional pertinent information

Matrix: DW = Drinking Water, GW = Ground Water, WW = Waste Water, SW = Sea Water, L = Liquid, S = Solid, SO = Soil, A = Air, F = Filter, T = Biological Tissue, O = Other

Preservation: R = Refrigerate (4°C), F= Freeze, N = Nitric Acid, H = Hydrochloric Acid, O = Other M = Methanol, MC = Methylene Chloride, SB = Sodium Bisulfite, C = Chloroform, S = Sulfuric Acid

CESE CHAIN OF CUSTODY

Center for Environmental Sciences and Engineering
University of Connecticut
3107 Horsebarn Hill Road; U-4210 Storrs, Ct 06269-5210
Phone: (860) 486-4015 Fax: (860) 486-5488

ORIGINAL

Turn Around Time in Working Days (Circle one)			
Standard	Rush	Priority	Other or Contractual
28 Day	14 Day	7 Day	
Regular Price	25% Surcharge	50% Surcharge	Discounts or Surcharges may apply

Reviewed By:

Company	CT DEEP Bureau of Water Protection and Land Reuse Water Monitoring & Assessment Unit	Project Contact	Meghan Lally	Billing Contact	
Project	**2022 Hockanum River PFAS Study** Shenipsit Lake - Fish Tissue Samples	Phone/Fax	860-424-3028 (Lab) or 203-313-4104 (Cell)	Phone	
Address	79 Elm Street	E-Mail	Please email data to DEEP.MonitoringData@ct.gov	E-Mail	
City	Hartford State CT Zip 06106	Reporting Request	Please email data to DEEP.MonitoringData@ct.gov	Purchase Order/ Reference Number	

SAMPLE TRANSFER (sign below)

1. Relinquished By: (print/sign) Ansel Aarestad	Date: 6-22-22 Time: 11:30	3. Relinquished By: (print/sign)	Date: Time:
2. Received By: (print/sign) Perkins	Date: 6/22/22 Time: 1230	4. Received By: (print/sign)	Date: Time:

Storage Location: Metals: Organics: Nutrients: VOC's Remediation: Other:

	Field Number	CESE ID	Collection Date	Collection Time	Matrix (Key Below)	Preservation (Key Below)	Number of Containers	Comments	PFAS	Chlordane	% Moisture	% Lipids	Test Parameter or CAS Number
1	14449-BB-1	220131-001	06/13/22	18:00	T	F	1	1 bag with 1 fish for individual analysis	X	-	X	X	per Meg. Lally 7/14/22
2	14449-BB-2	-002	06/13/22	18:00	T	F	1	1 bag with 1 fish for individual analysis	X	-	X	X	
3	14449-LMB-1	-003	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	X	X	X	Composite these two together
4	14449-LMB-2	-004	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	X	X	X	
5	14449-LMB-3	-005	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	X	X	X	
6	14449-YP-1	-006	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
7	14449-YP-2	-007	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
8	14449-YP-3	-008	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
9	14449-BG-1	-009	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
10	14449-BG-2	-010	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
11	14449-BG-3	-011	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	
12	14449-PS-1	-012	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	Meg Lally 7/14/22
13	14449-PS-2	-013	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	-	X	X	DO NOT RUN
14	14449-PS-3	-014	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	X	X	X	← CHLORDANE
15	14449-FFB-BN1	-015	06/13/22	18:00	T	F	1	1 bag w/ 5 fish for compositing and analysis	X	X	X	X	SA
16	14449-FLB-BN1	220131-016	06/13/22	18:00	T	F	1	**Do not analyze - hold with samples	-	-	-	-	Notes: filleting requested by client - reserve leftover samples
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Please Circle One: NON-HAZARDOUS HAZARDOUS HIGHLY CONTAMINATED UNKNOWN

******If needs to be preserved** add P next to preservation code ********

In comments area: designate MS/MSD sample for organics, if needs filtering, why hazardous, known sample matrix and analyte levels, or any additional pertinent information

Matrix: DW = Drinking Water, GW = Ground Water, WW = Waste Water, SW = Sea Water, L = Liquid, S = Solid, SO = Soil, A = Air, F = Filter, T = Biological Tissue, O = Other

Preservation: R = Refrigerate (4°C), F= Freeze, N = Nitric Acid, H = Hydrochloric Acid, O = Other M = Methanol, MC = Methylene Chloride, SB = Sodium Bisulfite, C = Chloroform, S = Sulfuric Acid

Note: chlordane analysis was not initially requested for yellow perch, bluegill and pumpkinseed samples collected from Shenipsit Lake. However, since results were reported by CESE they are included in this report

Appendix B-1. Shenipsit Lake Fish Details

All fish were collected by CT DEEP staff on June 13, 2022 and submitted as frozen whole fish to the University of Connecticut Center for Environmental Science and Engineering (UConn CESE) laboratory on June 22, 2022. Samples were prepared by UConn CESE on October 4, 2022 and analyzed on October 14, 2022.

DEEP Composite ID	DEEP Fish ID	Fish Species	Total Length (mm)	Tissue Anatomy	Sample Type	CESE Sample ID
14449-BB-1	22-F-769	Brown Bullhead	388	Fillet, skin on, scaled	Composite-5	220131-001
14449-BB-1	22-F-770	Brown Bullhead	375	Fillet, skin on, scaled	Composite-5	220131-001
14449-LMB-1	22-F-739	Largemouth Bass	381	Fillet, skin on, scaled	Composite-5	220131-003
14449-LMB-1	22-F-740	Largemouth Bass	303	Fillet, skin on, scaled	Composite-5	220131-003
14449-LMB-1	22-F-741	Largemouth Bass	363	Fillet, skin on, scaled	Composite-5	220131-003
14449-LMB-1	22-F-742	Largemouth Bass	340	Fillet, skin on, scaled	Composite-5	220131-003
14449-LMB-1	22-F-743	Largemouth Bass	341	Fillet, skin on, scaled	Composite-5	220131-003
14449-LMB-2	22-F-744	Largemouth Bass	321	Fillet, skin on, scaled	Composite-5	220131-004
14449-LMB-2	22-F-745	Largemouth Bass	352	Fillet, skin on, scaled	Composite-5	220131-004
14449-LMB-2	22-F-746	Largemouth Bass	420	Fillet, skin on, scaled	Composite-5	220131-004
14449-LMB-2	22-F-747	Largemouth Bass	342	Fillet, skin on, scaled	Composite-5	220131-004
14449-LMB-2	22-F-748	Largemouth Bass	346	Fillet, skin on, scaled	Composite-5	220131-004
14449-LMB-3	22-F-749	Largemouth Bass	351	Fillet, skin on, scaled	Composite-5	220131-005
14449-LMB-3	22-F-750	Largemouth Bass	295	Fillet, skin on, scaled	Composite-5	220131-005
14449-LMB-3	22-F-751	Largemouth Bass	375	Fillet, skin on, scaled	Composite-5	220131-005
14449-LMB-3	22-F-752	Largemouth Bass	374	Fillet, skin on, scaled	Composite-5	220131-005
14449-LMB-3	22-F-753	Largemouth Bass	387	Fillet, skin on, scaled	Composite-5	220131-005
14449-PS-1	22-F-754	Pumpkinseed	230	Fillet, skin on, scaled	Composite-5	220131-012
14449-PS-1	22-F-755	Pumpkinseed	226	Fillet, skin on, scaled	Composite-5	220131-012
14449-PS-1	22-F-756	Pumpkinseed	216	Fillet, skin on, scaled	Composite-5	220131-012
14449-PS-1	22-F-757	Pumpkinseed	215	Fillet, skin on, scaled	Composite-5	220131-012
14449-PS-1	22-F-758	Pumpkinseed	207	Fillet, skin on, scaled	Composite-5	220131-012
14449-PS-2	22-F-759	Pumpkinseed	195	Fillet, skin on, scaled	Composite-5	220131-013
14449-PS-2	22-F-760	Pumpkinseed	225	Fillet, skin on, scaled	Composite-5	220131-013
14449-PS-2	22-F-761	Pumpkinseed	213	Fillet, skin on, scaled	Composite-5	220131-013
14449-PS-2	22-F-762	Pumpkinseed	225	Fillet, skin on, scaled	Composite-5	220131-013
14449-PS-2	22-F-763	Pumpkinseed	213	Fillet, skin on, scaled	Composite-5	220131-013
14449-PS-3	22-F-764	Pumpkinseed	212	Fillet, skin on, scaled	Composite-5	220131-014
14449-PS-3	22-F-765	Pumpkinseed	183	Fillet, skin on, scaled	Composite-5	220131-014
14449-PS-3	22-F-766	Pumpkinseed	189	Fillet, skin on, scaled	Composite-5	220131-014
14449-PS-3	22-F-767	Pumpkinseed	185	Fillet, skin on, scaled	Composite-5	220131-014
14449-PS-3	22-F-768	Pumpkinseed	191	Fillet, skin on, scaled	Composite-5	220131-014
14449-BG-1	22-F-786	Bluegill	207	Fillet, skin on, scaled	Composite-5	220131-009
14449-BG-1	22-F-787	Bluegill	225	Fillet, skin on, scaled	Composite-5	220131-009
14449-BG-1	22-F-788	Bluegill	225	Fillet, skin on, scaled	Composite-5	220131-009
14449-BG-1	22-F-789	Bluegill	219	Fillet, skin on, scaled	Composite-5	220131-009
14449-BG-1	22-F-790	Bluegill	206	Fillet, skin on, scaled	Composite-5	220131-009

DEEP Composite ID	DEEP Fish ID	Fish Species	Total Length (mm)	Tissue Anatomy	Sample Type	CESE Sample ID
14449-BG-2	22-F-791	Bluegill	215	Fillet, skin on, scaled	Composite-5	220131-010
14449-BG-2	22-F-792	Bluegill	223	Fillet, skin on, scaled	Composite-5	220131-010
14449-BG-2	22-F-793	Bluegill	210	Fillet, skin on, scaled	Composite-5	220131-010
14449-BG-2	22-F-794	Bluegill	222	Fillet, skin on, scaled	Composite-5	220131-010
14449-BG-2	22-F-795	Bluegill	225	Fillet, skin on, scaled	Composite-5	220131-010
14449-BG-3	22-F-796	Bluegill	204	Fillet, skin on, scaled	Composite-5	220131-011
14449-BG-3	22-F-797	Bluegill	226	Fillet, skin on, scaled	Composite-5	220131-011
14449-BG-3	22-F-798	Bluegill	231	Fillet, skin on, scaled	Composite-5	220131-011
14449-BG-3	22-F-799	Bluegill	215	Fillet, skin on, scaled	Composite-5	220131-011
14449-BG-3	22-F-800	Bluegill	214	Fillet, skin on, scaled	Composite-5	220131-011

Appendix B-2. Union Pond Fish Details

All fish were collected by CT DEEP staff on June 23, 2022. Largemouth Bass and White Sucker samples were submitted as frozen whole fish to the University of Connecticut Center for Environmental Science and Engineering (UConn CESE) laboratory on June 29, 2022. Common Carp samples were submitted as frozen fillets on September 2, 2022. Samples were prepared by UConn CESE on October 4, 2022 and analyzed on October 14, 2022.

DEEP Composite ID	DEEP Fish ID	Fish Species	Total Length (mm)	Tissue Anatomy	Sample Type	CESE Sample ID
16186-CA-1(L)	22-F-802	Common Carp	451	Fillet, skin on, scaled	Composite-5	220252-001
16186-CA-1(L)	22-F-805	Common Carp	598	Fillet, skin on, scaled	Composite-5	220252-001
16186-CA-1(L)	22-F-809	Common Carp	598	Fillet, skin on, scaled	Composite-5	220252-001
16186-CA-1(L)	22-F-811	Common Carp	605	Fillet, skin on, scaled	Composite-5	220252-001
16186-CA-1(L)	22-F-813	Common Carp	567	Fillet, skin on, scaled	Composite-5	220252-001
16186-CA-2(L)	22-F-801	Common Carp	642	Fillet, skin on, scaled	Composite-5	220252-002
16186-CA-2(L)	22-F-810	Common Carp	662	Fillet, skin on, scaled	Composite-5	220252-002
16186-CA-2(L)	22-F-812	Common Carp	690	Fillet, skin on, scaled	Composite-5	220252-002
16186-CA-2(L)	22-F-814	Common Carp	651	Fillet, skin on, scaled	Composite-5	220252-002
16186-CA-2(L)	22-F-923	Common Carp	674	Fillet, skin on, scaled	Composite-5	220252-002
16186-CA-3(L)	22-F-803	Common Carp	606	Fillet, skin on, scaled	Composite-5	220252-003
16186-CA-3(L)	22-F-804	Common Carp	620	Fillet, skin on, scaled	Composite-5	220252-003
16186-CA-3(L)	22-F-806	Common Carp	630	Fillet, skin on, scaled	Composite-5	220252-003
16186-CA-3(L)	22-F-807	Common Carp	609	Fillet, skin on, scaled	Composite-5	220252-003
16186-CA-3(L)	22-F-808	Common Carp	640	Fillet, skin on, scaled	Composite-5	220252-003
16186-LMB-1	22-F-831	Largemouth Bass	480	Fillet, skin on, scaled	Discrete	220140-004
16186-LMB-2	22-F-836	Largemouth Bass	361	Fillet, skin on, scaled	Composite-5	220140-005
16186-LMB-2	22-F-837	Largemouth Bass	366	Fillet, skin on, scaled	Composite-5	220140-005
16186-LMB-2	22-F-840	Largemouth Bass	331	Fillet, skin on, scaled	Composite-5	220140-005
16186-LMB-2	22-F-841	Largemouth Bass	368	Fillet, skin on, scaled	Composite-5	220140-005
16186-LMB-2	22-F-843	Largemouth Bass	323	Fillet, skin on, scaled	Composite-5	220140-005
16186-LMB-3	22-F-833	Largemouth Bass	306	Fillet, skin on, scaled	Composite-5	220140-006
16186-LMB-3	22-F-834	Largemouth Bass	305	Fillet, skin on, scaled	Composite-5	220140-006
16186-LMB-3	22-F-838	Largemouth Bass	315	Fillet, skin on, scaled	Composite-5	220140-006
16186-LMB-3	22-F-842	Largemouth Bass	315	Fillet, skin on, scaled	Composite-5	220140-006
16186-LMB-3	22-F-844	Largemouth Bass	296	Fillet, skin on, scaled	Composite-5	220140-006
16186-LMB-4	22-F-830	Largemouth Bass	299	Fillet, skin on, scaled	Composite-4	220140-007
16186-LMB-4	22-F-832	Largemouth Bass	293	Fillet, skin on, scaled	Composite-4	220140-007
16186-LMB-4	22-F-835	Largemouth Bass	233	Fillet, skin on, scaled	Composite-4	220140-007
16186-LMB-4	22-F-839	Largemouth Bass	232	Fillet, skin on, scaled	Composite-4	220140-007
16186-WS-1	22-F-815	White Sucker	373	Fillet, skin on, scaled	Composite-5	220140-001
16186-WS-1	22-F-816	White Sucker	420	Fillet, skin on, scaled	Composite-5	220140-001
16186-WS-1	22-F-817	White Sucker	432	Fillet, skin on, scaled	Composite-5	220140-001
16186-WS-1	22-F-818	White Sucker	479	Fillet, skin on, scaled	Composite-5	220140-001
16186-WS-1	22-F-819	White Sucker	405	Fillet, skin on, scaled	Composite-5	220140-001

DEEP Composite ID	DEEP Fish ID	Fish Species	Total Length (mm)	Tissue Anatomy	Sample Type	CESE Sample ID
16186-WS-2	22-F-820	White Sucker	374	Fillet, skin on, scaled	Composite-5	220140-002
16186-WS-2	22-F-821	White Sucker	382	Fillet, skin on, scaled	Composite-5	220140-002
16186-WS-2	22-F-822	White Sucker	391	Fillet, skin on, scaled	Composite-5	220140-002
16186-WS-2	22-F-823	White Sucker	432	Fillet, skin on, scaled	Composite-5	220140-002
16186-WS-2	22-F-824	White Sucker	393	Fillet, skin on, scaled	Composite-5	220140-002
16186-WS-3	22-F-825	White Sucker	396	Fillet, skin on, scaled	Composite-5	220140-003
16186-WS-3	22-F-826	White Sucker	372	Fillet, skin on, scaled	Composite-5	220140-003
16186-WS-3	22-F-827	White Sucker	400	Fillet, skin on, scaled	Composite-5	220140-003
16186-WS-3	22-F-828	White Sucker	416	Fillet, skin on, scaled	Composite-5	220140-003
16186-WS-3	22-F-829	White Sucker	375	Fillet, skin on, scaled	Composite-5	220140-003

Appendix C. Laboratory Analytical Results

Center for Environmental Sciences and Engineering University of Connecticut Annex 4 Building 3107 Horsebarn Hill Road, Unit 4210 Storrs, CT 06269-4210	Fax # (860) 486-5488 Telephone # (860) 486-4015 Email: cesecustserv@uconn.edu Analysts: A. Provatas	CT DEEP - Hockanum River Order #s 220131, 220140 and 220252 Matrix: Tissue Contact: M. Lally Report Date: 10/21/22 Reported by: C. Perkins

Instrument				GC-MS/MS	GC-MS/MS	GC-MS/MS
Units	WET WEIGHT			ng/g	ng/g	ng/g
Prep date				10/4/22	10/4/22	10/4/22
Analysis date				10/14/22	10/14/22	10/14/22
CESE ID	Field ID	Collected	Recieved	oxychlordane	trans(gamma)-chlordane	cis(alpha)-chlordane
220131-001 and 002	14449-BB-1 and 14449-BB-2	6/13/2022	06/22/22	ND	1.15	1.36
220131-003	14449-LMB-1	6/13/2022	06/22/22	ND	ND	ND
220131-004	14449-LBM-2	6/13/2022	06/22/22	ND	ND	0.84
220131-005	14449-LBM-3	6/13/2022	06/22/22	ND	ND	ND
220131-006	14449-YP-1	6/13/2022	06/22/22	ND	ND	ND
220131-007	14449-YP-2	6/13/2022	06/22/22	ND	ND	1.30
220131-008	14449-YP-3	6/13/2022	06/22/22	ND	0.46	ND
220131-009	14449-BG-1	6/13/2022	06/22/22	ND	ND	ND
220131-010	14449-BG-2	6/13/2022	06/22/22	ND	0.79	ND
220131-011	14449-BG-3	6/13/2022	06/22/22	ND	ND	ND
220131-012	14449-PS-1	6/13/2022	06/22/22	ND	ND	ND
220131-013	14449-PS-2	6/13/2022	06/22/22	ND	ND	ND
220131-014	14449-PS-3	6/13/2022	06/22/22	ND	ND	ND
220131-015	14449-FFB-BN-1	6/13/2022	06/22/22	ND	ND	ND
220140-001	16186-WS-1	6/23/2022	06/29/22	2.61	5.98	6.05
220140-002	16186-WS-2	6/23/2022	06/29/22	3.53	6.16	6.30
220140-003	16186-WS-3	6/23/2022	06/29/22	ND	4.18	4.64
220140-004	16186-LMB-1	6/23/2022	06/29/22	ND	1.56	1.48
220140-005	16186-LMB-2	6/23/2022	06/29/22	2.44	1.74	1.74
220140-006	16186-LMB-3	6/23/2022	06/29/22	ND	1.12	1.65
220140-007	16186-LMB-4	6/23/2022	06/29/22	ND	1.52	1.93
220252-001	16186-CA-1(L)	6/13/2022	09/02/22	2.97	8.99	8.15
220252-002	16186-CA-2(L)	6/13/2022	09/02/22	ND	3.78	4.03
220252-003	16186-CA-3(L)	6/13/2022	09/02/22	2.15	10.46	10.60
			Reporting Limit	0.17	0.10	0.08

Notes:

1. The two Brown Bullhead collected from Lake Shenipsit were initially submitted as discrete (i.e., individual fish) samples. Each fish was therefore initially assigned a unique Field ID (i.e., DEEP Composite ID) and a unique CESE ID. It was later decided to composite these two fish into a single sample. The composited sample is referred to as Field ID/DEEP Composite ID 14449-BB-1 and CESE ID 220131-001 throughout the report. There are no unique data associated with the Field ID/DEEP Composite ID 14449-BB-2 and CESE ID 220131-002.

Tim Strzepa, Melissa Czarnowski, Walter Tokarz, and Meghan Lally of the CT DEEP Water Monitoring and Assessment Program prepare to collect fish for tissue samples from Shenipsit Lake in June 2022.